

We claim:

1. A lubrication system for a planetary transmission having

(i) a first gear set including a first sun gear and at least one first planetary gear in meshing arrangement with the first sun gear,

(ii) a second gear set including a second sun gear and at least one second planetary gear in meshing arrangement with the second sun gear, the second sun gear having a hollow interior,

(iii) a casing surrounding the first gear set and the second gear set,

(iv) a first thrust washer between the first sun gear and the second sun gear, and

(v) a second thrust washer between the second sun gear and the casing, said lubrication system comprising:

a passageway extending through the casing and placing the hollow interior of the second sun gear in fluid communication with a mesh point between teeth of the second sun gear and teeth of the at least one second planetary gear, such that when oil is forced from the mesh point the oil travels through said passageway, into the hollow interior of the second sun gear, and into contact with the first and second thrust washers.

2. The lubrication system according to claim 1,

wherein the casing includes an opening in alignment with the second sun gear and a cover closing the opening, with the second thrust washer being between the second sun gear and the cover, and

wherein said passageway extends through the cover.

3. The lubrication system according to claim 2,

wherein the cover includes a first portion and a second portion that are bolted together, and wherein said passageway includes a first opening extending through the first portion, a second opening extending through the first portion, and a cavity in the second portion interconnecting said first opening and said second opening,

such that when oil is forced from the mesh point the oil travels through said first opening, then

through said cavity, and then through said second opening into the hollow interior of the second sun gear.

4. The lubrication system according to claim 3, further comprising:

5 a first tubular extension extending from said second opening into the hollow interior of the second sun gear and toward the first thrust washer.

5. The lubrication system according to claim 4, further comprising:

10 a hole in a sidewall of said first tubular extension, said hole being positioned above the second thrust washer so as to allow oil to flow through said hole and into contact with the second thrust washer.

6. The lubrication system according to claim 3, further comprising:

15 a second tubular extension extending from said first opening toward the mesh point between the teeth of the second sun gear and the teeth of the at least one second planetary gear.

7. The lubrication system according to claim 3, further comprising:

20 a third opening extending through the second sun gear from a root portion of teeth thereof to the hollow interior of the second sun gear so as to allow oil to flow through the third opening into the hollow interior of the second sun gear.

8. A planetary transmission comprising:

a first gear set including a first sun gear and at least one first planetary gear in meshing arrangement with said first sun gear;

25 a second gear set including a second sun gear and at least one second planetary gear in meshing arrangement with said second sun gear, said second sun gear having a hollow interior;

a casing surrounding said first gear set and said second gear set;

a first thrust washer between said first sun gear and said second sun gear;

a second thrust washer between said second sun gear and said casing; and

a lubrication system including a passageway extending through said casing and placing said hollow interior of said second sun gear in fluid communication with a mesh point between teeth of said second sun gear and teeth of said at least one second planetary gear, such that when oil is forced from the mesh point the oil travels through said passageway, into said hollow interior of said second sun gear, and into contact with said first and second thrust washers.

9. The planetary transmission according to claim 8, wherein said casing includes an opening in alignment with said second sun gear and a cover closing said opening, with said second thrust washer being between said second sun gear and said cover, and said passageway extends through said cover.

10. The planetary transmission according to claim 9, wherein said cover includes a first portion and a second portion that are bolted together, and said passageway includes a first opening extending through said first portion, a second opening extending through said first portion, and a cavity in said second portion interconnecting said first opening and said second opening, such that when oil is forced from the mesh point the oil travels through said first opening, then through said cavity, and then through said second opening into said hollow interior of said second sun gear.

11. The planetary transmission according to claim 10, further comprising: a first tubular extension extending from said second opening into said hollow interior of said second sun gear and toward said first thrust washer.

12. The planetary transmission according to claim 11, further comprising: a hole in a sidewall of said first tubular extension, said hole being positioned above said second thrust washer so as to allow oil to flow through said hole and into contact with said second thrust washer.

13. The planetary transmission according to claim 10, further comprising:
a second tubular extension extending from said first opening toward the mesh point between the teeth of said second sun gear and the teeth of said at least one second planetary gear.

5 14. The planetary transmission according to claim 10, further comprising:
a third opening extending through said second sun gear from a root portion of teeth thereof to said hollow interior of said second sun gear so as to allow oil to flow through said third opening into said hollow interior of said second sun gear.

10 15. A vehicle comprising:
a ground engaging wheel; and
a planetary transmission for driving said ground engaging wheel, said planetary transmission including

(i) a first gear set including a first sun gear and at least one first planetary gear in
15 meshing arrangement with said first sun gear,

(ii) a second gear set including a second sun gear and at least one second planetary gear in meshing arrangement with said second sun gear, said second sun gear having a hollow interior,

(iii) a casing surrounding said first gear set and said second gear set,

20 (iv) a first thrust washer between said first sun gear and said second sun gear,

(v) a second thrust washer between said second sun gear and said casing, and

25 (vi) a lubrication system including a passageway extending through said casing and placing said hollow interior of said second sun gear in fluid communication with a mesh point between teeth of said second sun gear and teeth of said at least one second planetary gear, such that when oil is forced from the mesh point the oil travels through said passageway, into said hollow interior of said second sun gear, and into contact with said first and second thrust washers.

16. The vehicle according to claim 15, wherein
said casing includes an opening in alignment with said second sun gear and a cover closing

said opening, with said second thrust washer being between said second sun gear and said cover, and said passageway extends through said cover.

17. The vehicle according to claim 16, wherein
5 said cover includes a first portion and a second portion that are bolted together, and said passageway includes a first opening extending through said first portion, a second opening extending through said first portion, and a cavity in said second portion interconnecting said first opening and said second opening,

10 such that when oil is forced from the mesh point the oil travels through said first opening, then through said cavity, and then through said second opening into said hollow interior of said second sun gear.

18. The vehicle according to claim 17, further comprising:
a first tubular extension extending from said second opening into said hollow interior of said
15 second sun gear and toward said first thrust washer.

19. The vehicle according to claim 18, further comprising:
a hole in a sidewall of said first tubular extension, said hole being positioned above said
second thrust washer so as to allow oil to flow through said hole and into contact with said second
20 thrust washer.

20. The vehicle according to claim 17, further comprising:
a second tubular extension extending from said first opening toward the mesh point between
the teeth of said second sun gear and the teeth of said at least one second planetary gear.

21. The vehicle according to claim 17, further comprising:
a third opening extending through said second sun gear from a root portion of teeth thereof
to said hollow interior of said second sun gear so as to allow oil to flow through said third opening
into said hollow interior of said second sun gear.

22. A lubricating method comprising:

in a planetary transmission including

(i) a first gear set including a first sun gear and at least one first planetary gear in meshing arrangement with said first sun gear,

(ii) a second gear set including a second sun gear and at least one second planetary gear in meshing arrangement with said second sun gear, said second sun gear having a hollow interior,

(iii) a casing surrounding said first gear set and said second gear set, with said casing having a passageway extending therethrough which places said hollow interior of said second sun gear in fluid communication with a mesh point between teeth of said second sun gear and teeth of said at least one second planetary gear,

(iv) a first thrust washer between said first sun gear and said second sun gear, and

(v) a second thrust washer between said second sun gear and said casing, forcing oil from said mesh point, through said passageway, into said hollow interior of said second sun gear, and into contact with said first and second thrust washers.

23. The method according to claim 22, wherein

said casing includes an opening in alignment with said second sun gear and a cover closing said opening, with said second thrust washer being between said second sun gear and said cover, and said passageway extends through said cover,

such that forcing oil from said mesh point, through said passageway, into said hollow interior of said second sun gear and into contact with said first and second thrust washers comprises forcing oil from said mesh point, through said cover, into said hollow interior of said second sun gear, and into contact with said first and second thrust washers.

24. The method according to claim 23, wherein

said cover includes a first portion and a second portion that are bolted together, and

said passageway includes a first opening extending through said first portion, a second opening extending through said first portion, and a cavity in said second portion interconnecting said

first opening and said second opening,

such that forcing said oil from said mesh point, through said cover and into said hollow interior of said second sun gear comprises forcing said oil from said mesh point, through said first opening, then through said cavity, and then through said second opening into said hollow interior of said second sun gear.

25. The method according to claim 24, wherein

said planetary transmission further includes a first tubular extension extending from said second opening into said hollow interior of said second sun gear and toward said first thrust washer, and

forcing said oil from said mesh point, through said first opening, then through said cavity, and then through said second opening into said hollow interior of said second sun gear comprises forcing said oil from said mesh point, through said first opening, then through said cavity, then through said second opening, then through said first tubular extension into said hollow interior of said second sun gear.

26. The method according to claim 25, wherein

a hole is in a sidewall of said first tubular extension and positioned above said second thrust washer, and

forcing said oil through said first tubular extension into said hollow interior of said second sun gear comprises forcing said oil through said hole and through an open end of said first tubular extension into said hollow interior of said sun gear.

27. The method according to claim 24, wherein

said planetary transmission further includes a second tubular extension extending from said first opening toward the mesh point between the teeth of said second sun gear and the teeth of said at least one second planetary gear, and

forcing said oil from said mesh point through said first opening comprises forcing said oil from said mesh point, through said second tubular extension, and then through said first opening.

28. The method according to claim 24, wherein a third opening extends through said second sun gear from a root portion of teeth thereof to said hollow interior of said second sun gear, and said method further comprises:

forcing oil through said third opening into said hollow interior of said second gear.

29. A method of modifying a planetary transmission that includes

(i) a first gear set including a first sun gear and at least one first planetary gear in meshing arrangement with said first sun gear,

(ii) a second gear set including a second sun gear and at least one second planetary gear in meshing arrangement with said second sun gear, said second sun gear having a hollow interior,

(iii) a casing surrounding said first gear set and said second gear set, said casing including an opening in alignment with said second sun gear and a cover closing said opening,

(iv) a first thrust washer between said first sun gear and said second sun gear, and

(v) a second thrust washer between said second sun gear and said cover, said method comprising:

defining a passageway that extends through said cover and places said hollow interior of said second sun gear in fluid communication with a mesh point between teeth of said second sun gear and teeth of said at least one second planetary gear, such that when oil is forced from the mesh point the oil travels through said passageway, into said hollow interior of said second sun gear, and into contact with said first and second thrust washers.

30. The method according to claim 29, wherein

defining a passageway that extends through said cover comprises

(i) forming in said cover a first opening that is aligned with the mesh point between the teeth of said second sun gear and the teeth of said at least one second planetary gear,

(ii) forming in said cover a second opening that is aligned with said hollow interior of said second sun gear, and

(iii) bolting a cover piece to said cover, with said cover piece having a cavity therein

that interconnects said first opening and said second opening,

such that when oil is forced from the mesh point the oil travels through said first opening, then through said cavity, and then through said second opening into said hollow interior of said second sun gear.

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31. The method according to claim 30, further comprising:

providing a first tubular extension that extends from said second opening into said hollow interior of said second sun gear and toward said first thrust washer.

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32. The method according to claim 31, further comprising:

providing a hole in a sidewall of said first tubular extension, said hole being positioned above said second thrust washer.

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33. The method according to claim 30, further comprising:

providing a second tubular extension that extends from said first opening toward the mesh point between the teeth of said second sun gear and the teeth of said at least one second planetary gear.

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34. The method according to claim 30, wherein

said planetary transmission further includes an opening extending through said second sun gear from a root portion of teeth thereof to said hollow interior of said second sun gear.

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35. A cover for covering an opening in a casing of a planetary transmission, comprising:

a passageway extending through said cover, said passageway being constructed and arranged to supply oil to a hollow interior of a sun gear of the planetary transmission so as to lubricate first and second thrust washers of the planetary transmission.

36. The cover according to claim 35, further comprising:

a first portion and a second portion that are bolted together,

wherein said passageway includes a first opening extending through said first portion, a second opening extending through said first portion, and a cavity in said second portion
5 interconnecting said first opening and said second opening,

such that oil is to flow through said first opening, then through said cavity, and then through said second opening into the hollow interior of the sun gear.

37. The cover according to claim 36, further comprising:

10 a first tubular extension extending from said second opening such that oil is to flow through said second opening, through said first tubular extension, and then into the hollow interior of the sun gear.

38. The cover according to claim 37, further comprising:

15 a hole in a sidewall of said first tubular extension such that oil is to flow through said hole and into contact with the second thrust washer.

39. The cover according to claim 36, further comprising:

20 a second tubular extension extending from said first opening such that oil is to flow through said second tubular extension and then through said first opening.